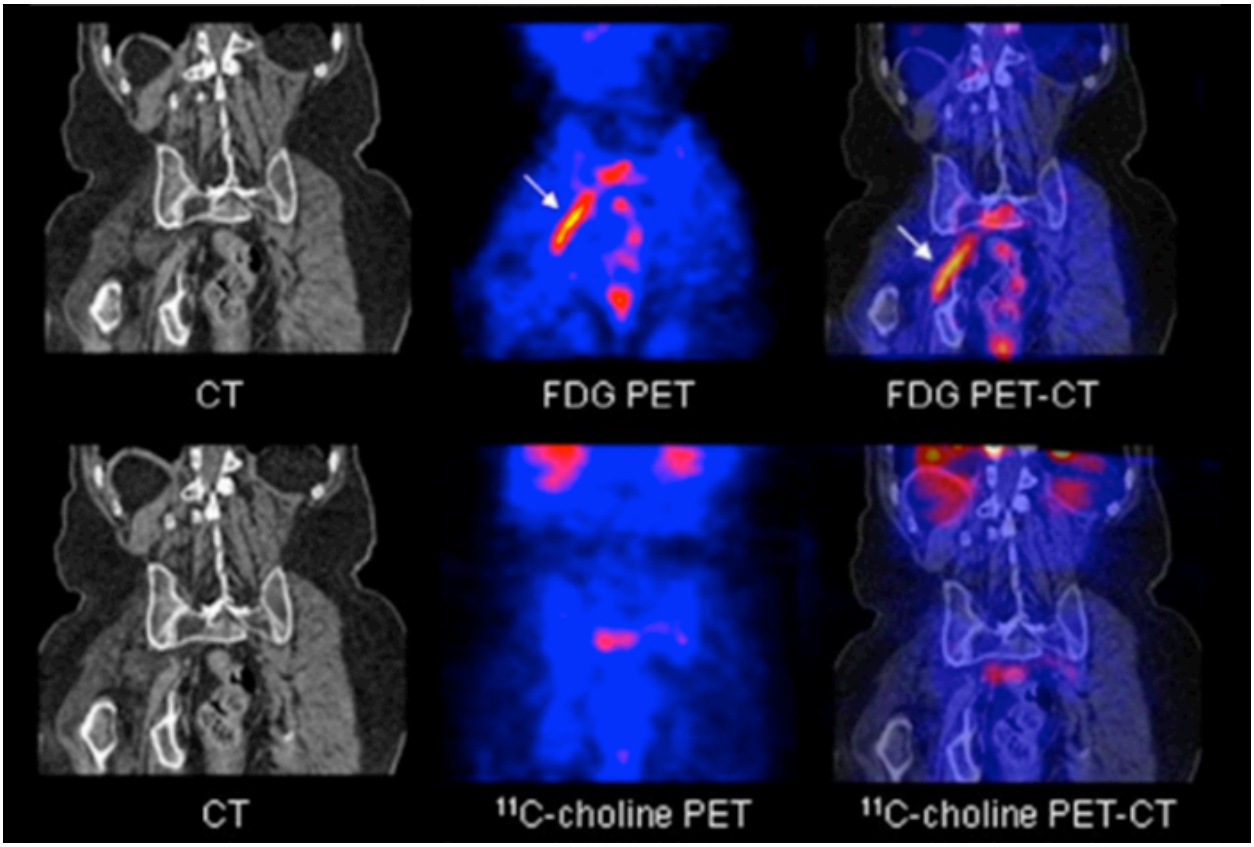
What is the difference between an X-ray, a CT scan, and an MRI?

December 1, 2016



X-rays are a form of electromagnetic radiation, like light. They are less energetic than gamma rays and more energetic than ultraviolet light. They pass easily through soft tissue such as organs and muscles. They don't pass as easily through hard tissue such as bones and teeth, so they produce images of skeletal structures—the X-ray images we are most familiar with. Additionally, sometimes a person ingests or is injected with an opaque X-ray fluid that will fill a space of interest for X-ray imaging.

A computerized tomography (CT) scan is usually a series of X-rays taken from different angles and then assembled into a three-dimensional model by a computer. Tomography means a picture of a slice. While an X-ray may show edges of soft tissues all stacked on top of each other, the computer used for a CT scan can figure out how those edges relate to each other in space, so the CT image is more useful for understanding blood vessels and soft tissue.

Another kind of CT scan uses positrons. I have to mention this because positrons are antimatter electrons. (Yes, antimatter does exist, and it is useful!) In positron emission tomography (PET), a person is injected with a tracer—a special dye containing a

positron-emitting radionuclide (radioactive material)—and the organs and tissues absorb this tracer. When highlighted under a PET scanner, the tracer can help show how well organs and tissues are working. A PET scan can measure blood flow, oxygen use, the body's use of sugar, and much more.

In magnetic resonance imaging (MRI), radio waves of a specific frequency are used to jostle the nuclei of hydrogen atoms, which are plentiful in both water and fats. Powerful magnets detect the hydrogen response and map the locations of the tissues where the hydrogen resides. An MRI does not use ionizing radiation (such as X-rays), and the radio waves are longer and have lower energy than visible light or microwaves have. Most MRI machines are huge and very expensive. A group here at Los Alamos is building an ultra-sensitive, low-power MRI that will fit in a pick-up truck. The group hopes it will find applications in battlefield medicine and in Third World countries that can't afford conventional MRI equipment. It is an exciting project.

I have enjoyed learning this material and passing it along to you, so thank you for asking! I hope you found your visit to our Museum interesting.

Gordon McDonough, Science evangelist

Occasionally questions are sent in to edu-bsm@lanl.gov or are left in our feedback box in the Museum.

We work to provide answers to these questions on our blog and the site where we list our favorite questions and answers.